IN-LINE SKATE SUSPENSION SYSTEM WITH BRAKE

Cross Reference to Related Applications

This is a continuation-in-part of U.S. patent application serial No. 09/580,042 filed May 26, 2000 which in turn is a continuation of U.S. patent application serial No. 09/210,464 filed December 12, 1998 which is a continuation-in-part of U.S. patent application serial No. 08/971,044 filed November 14, 1997.

Technical Field

The present invention relates to inline skates, and in particular to inline skates having a suspension system allowing independent up and down movement of each wheel wherein the wheels are mounted on pivotable wheel supports which are provided with related shock absorbing elements as well as brakes for engaging a wheel to slow and stop the skate.

Background of the Invention

Inline skates have been in popular use for some time and provide recreation for a large number of people. Present use of inline skates is normally restricted to riding on smooth firm surfaces, such as asphalt and concrete. However, many roads are not smooth, being pebbled asphalt, non-smooth asphalt, hard packed dirt, hard packed sand, graveled, uneven/rutty surfaces, uneven sectioned concrete slabs and a multitude of other rough surfaces. The small wheels and rigid suspension systems or wheel supports do not permit riding over such rough terrain.

Adventurous skaters would enjoy going off road onto natural rough and hilly terrain, grassy and rocky areas, for freely exploring the off-road experience.

Prior art devices intended for off-road use don't meet the need for a multi-reaction

suspension system which would be necessary in using the skates over all types of terrain, to absorb shock from bumps and jumps of large and small impact.

U.S. patent # 5,411,277 claims a multi-terrain in-line skate chassis, but only provides enlarged wheels with treads, the wheels offset from a vertical support plate. It does not provide shock absorbing wheels and a shock absorbing wheel support system.

Several U.S. patents, including #5,085,445; 5,503,413 and 2,552,987 provide inline skates with springs suspending the tires in different fashions, but do not provide multiple reaction shock absorbing features or inflated heavily treaded tires.

U.S. patent #5,405,156 provides inline skates with two sets of two wheels each set on a cantilever which pivots in the center and has a spring on the end and a sliding bumper in-between. It does not allow for independent movement of each wheel and does not provide treaded tires.

None of the prior art devices provide interchangeable shock absorption systems to vary the compressibility or resiliency for different uses, different terrains, and different users.

Skaters can build up considerable speed, especially outdoors and going downhill. It is important to the safety of the skater and to the safety of other people and objects in the path of the skater that the skater have a dependable braking means for slowing and stopping.

With inline skates the speed achieved is often greater than with traditional roller skates and they tend to be used more often outdoors with the many obstacles and downhill grades that increase the danger. Balance on inline skates is also much more difficult than with traditional roller skates. Therefore, a safe dependable inline braking system which may be engaged with the skater facing forward in the direction of travel would be very helpful to insure the safety of the

skater and others.

Many prior art inline skate brakes use a rubberized brake pad extending off the back of one of the skates. Engaging the brake pad with the ground for stopping requires an extreme tilting of the skate backward with the toe substantially elevated. On rough terrain the contact with the ground is uneven and undependable. The brake may lose contact with the ground or contact a slick surface without sufficient friction, thereby not slowing or stopping the skater and possibly causing a disaster.

U.S. Patents #5,342,071 and #5,135,244 both provide pivotable wheel supports on inline skates with braking surfaces engaged by tilting the skate boot to engage the brake surface against a skate wheel, but neither patent provides a means to avoid accidental engagement of the brake caused by the wheel support tilting upward on rough terrain to engage the brake accidently.

U.S. Patents #5,192,099 and #5,755,450 both provide inline skate brakes which engage one of the skate wheels by leaning back on the boot. These systems would not work on inline skates with pivotable wheel supports for the same reason as the two patents above that the brakes would be engaged accidently by traveling over rough terrain.

U.S. Patent #5,511,803 provides an inline skate brake with an extra brake wheel mounted behind the other wheels and normally elevated above the ground. By leaning back on the skate boot the brake wheel touches the ground and engages a braking surface against the wheel. The extra wheel protrudes far beyond the skate boot and could cause problems banging into the other skate boot or external objects. This system also would not work with pivotable wheel supports because it could be accidently engaged on rough terrain.

U.S. Patent #5,785,326 provides an inline skate brake which engages both the ground and

a skate wheel. This would not work smoothly on rough terrain and also could be accidently engaged on rough terrain if used with pivotable wheel supports.

None of the prior art inline skate brakes provide a means to accommodate the movement of the wheel supports over rough terrain which is liable to cause accidental braking by the wheels contacting the braking surface by mistake.

Disclosure of the Invention

A primary object of the present invention is to provide pivotable wheel supports and integrated compressible bumpers for inline skates which enable the wheels to bounce independently over rough terrain to absorb the shock that would otherwise be experienced by the skater, enabling the skates to be used for a full range of different conditions including rough roads, ruts, jumps, and any other usage creating jolts to the skates.

A secondary object of the present invention is to provide a molded front and a back pivotable wheel support with two wheels on each and a wedge-shaped compressible bumper in a V-shaped cradle on each wheel support to enable each wedge-shaped bumper contacting each wheel support to absorb shocks alternately from each of the two wheels on each support as the wheel encounters uneven terrain and elevates to pivot the support to provide a smooth ride with a system that is inexpensive to manufacture.

A corollary object of the present invention is to provide a pivotable connection between each wheel support and the skate boot having a slot with both vertical and horizontal openings within which slot a pivot pin is capable of rotating and moving both vertically and horizontally and in any combination of movements. The compressible wedge-shaped bumper is capable of

absorbing shocks from the wheel support as it pivots when each wheel separately encounters uneven terrain, as it moves vertically when both wheels encounter uneven terrain, as it moves horizontally when the forward wheel encounters a large obstacle causing the wheel support to move rearwardly, and all combinations of motion of the wheel support caused by the wheels encountering uneven terrain.

A related object of the present invention is to provide an optional hollow core in each wedge-shaped bumper adjacent to each wheel (two cores per bumper) to receive changeable core inserts having varying degrees of compressibility to enable adjustability of the shock absorption of the skates for various surface conditions, uses of the skates, and for different users.

Another object of the present invention is to have shock absorbing bumpers which extend across the width of the wheel supports to stabilize the skate laterally and enable absorption of the shocks caused from the wheels hitting objects at odd angles against the sides of the wheels.

A further object of the present invention is to provide two inner wheel axle holes on each wheel support to enable the inner wheels to be mounted higher than the outer wheels for a "rockering" effect.

An additional object of the present invention is to provide the option of having a front wheel and a rear wheel elevated higher than the other wheels to enable the skate to approach and depart from inclines and objects in the path of the skate more smoothly and act as ramps.

One more object of the present invention is to provide a guard extending below the skate boot around the suspension system to protect it from damage, dust, dirt, and water. A flexible accordion-type portion of the guard between the wheels and the boot enables flexing of the guard with wheel movement in a guard attached to the wheels at the axles.

Still another object of the present invention is to add a pivotal brake to the system to provide a means for slowing and stopping the skate without inhibiting the suspension action.

A contributory object of the present invention is to provide a brake for the system which engages one of the wheels of the skate and therefore does not rely on contact with the ground for stopping to produce a smoother more controlled slowing and stopping because the brake is engaging the smooth surface of the wheel rather than the often rough surface of the terrain as in other brakes that engage the ground to slow and stop.

A related object of the present invention is to provide a brake for the system which is engaged by leaning back on the skate elevating only the front wheel support and leaving both wheels of the rear wheel support in contact with the ground for more stability while braking.

Another related object of the present invention is to provide an inline skate brake mounted above the rear wheel between the rear wheel and the skate boot so that the brake never encounters the ground or external objects to make the skate of the present invention more maneuverable and less prone to accidental slowdowns, stops or jolts than conventional inline skate brakes that extend far behind the skate boot and are very close to the ground.

Another corollary object of the present invention is to provide a skate brake attached to the pivotable wheel support by a pivotal means and to the skate boot in a sliding track to enable the brake to move up and down in response to the movement of the wheel support when encountering uneven terrain and preventing accidental engagement of the brake.

An ancillary object of the present invention is to provide a skate brake with an adjustable high friction braking surface making it closer to or further from the engaging wheel to enable the skater to adjust the brake according to skating conditions, the skater's skill level, and desired

sensitivity of brake response as well as to adjust for wear.

Yet another object of the present invention is to provide a skate brake with a high friction braking surface that is durable and not subject to wearing down, such as a grindstone surface, thereby providing a more permanent brake that does not require constant replacement and ensuring the brake will always function properly. Replacement of the rear wheel from brake frictional wear is considerably easier, since wheels are readily available everywhere skating equipment is sold.

In brief, a number of pivotable wheel supports, formed of injection molded reinforced nylon or other hard plastic or aluminum, are pivotally interconnected with each other and with a boot sole mounting plate to allow individual movement of each wheel upon encountering obstacles and variations in terrain to enable skating in a great variety of terrains with relative comfort to the skater. The components are inexpensively manufactured and easily assembled and secured together by pins allowing pivoting between components.

In the preferred embodiment, a front and a back wheel support or truck are each pivotally attached to a mounting plate fixed to the bottom of the sole of the skate boot. The pivot holes in the sole plate may be slotted both vertically and horizontally to allow the trucks a greater range of motion including pivoting, horizontal motion, vertical motion and any combination of motions.

As used herein, vertically or vertical movement refers to up and down movement of the truck or wheel support member relative to the bottom of the boot which can also be described as movement to and from the bottom of the boot in the plane in which the skate wheels rotate. Horizontal movement of the truck or wheel support member refers to back and forth movement relative to the boot which can also be described as movement towards the front or toe area of the

boot and in the opposite direction towards the rear or heel area of the boot also in the plane in which the wheels rotate.

Continuing, each truck has side plates with axle holes to receive two wheels pivotally attached to the truck in linear alignment between the plates. Each truck may be provided with two or more inner axle holes to allow the inner wheels to be positioned at different heights off the ground than the outer wheels to produce a "rockering" effect. The trucks are interconnected by a rigid link member pivotally connected to each truck at the axle of the inner wheel to provide a co-planar suspension action that resists torsional forces thereby providing greater stability to the suspension system and preventing the trucks and wheels from contacting each other.

Each truck is provided with a V-shaped cradle above the two wheels. A single wedge-shaped compression bumper fits in the V-shaped cradle and contacts the sole plate to absorb shocks from each of the two wheels as each wheel is bumped up and the truck pivots. Alternately two separate bumpers could be used for each truck with each bumper positioned between the sole plate and one side of the V-shaped cradle.

The compression bumpers are preferably fabricated of a resilient elastomeric material such as URETHANE® and have a hollow core corresponding to each side of the V-shaped cradle above each wheel. Interchangeable inserts of varying compressibility are insertable in the cores to vary the shock absorption of the wedges to meet the different shock absorption requirements for various uses of the skates and for different users. The interchangeable inserts may be fabricated of an elastomer such as URETHANE® of varying density, or fabricated as an air-filled bladder with or without a pump, or other type of compressible element. For the wedge-shaped bumper, it is preferred to use a single interchangeable core element with two core pin

inserts interconnected by a common handle.

The front and rear trucks are interconnected by a truck link pivotally attached teach truck either at the axle hole or at a separate pivot point on the inside of each truck. The truck link is a rigid elongated H-shaped element fabricated of injection molded reinforced nylon or hard plastic or cast aluminum or other rigid material.

The wheels may be standard in-line skate wheels (profiled for various uses) or oversized (several times the diameter and width of conventional roller skate wheels).

Alternately, a front and back pivotable wheel support with a pivotally connected rigid link therebetween may be used with URETHANE® bumpers attached to the sole plate with a front and rear bumper contacting the front and rear wheel supports and a middle bumper contacting the rigid connecting link. A single pivotable wheel support may be used with a front and rear bumper.

An advantage of the present invention is that it enables an inline skater to skate over a wide variety of different types of terrain, including offroad skating.

Another advantage of the present invention is that it provides a means of absorbing shock from any type of wheel and wheel support movement including pivoting, vertical, horizontal, lateral, and any combination of movement.

One more advantage of the present invention is that is provides smooth adjustably controlled braking means regardless of the terrain conditions.

Yet another advantage of the present invention is that it provides smoother safer inline skating with no accidental encounters of the brake with the ground and highly unlikely encounters of the brake with other objects including the other skate.

Still another advantage of the present invention is that it provides an inexpensive and easy to fabricate means of producing skates which produce a smooth, controlled, ride over wide variations in terrain.

Brief Description of the Drawings

These and other details of my invention will be described in connection with the accompanying drawings, which are furnished only by way of illustration and not in limitation of the invention, and in which drawings:

FIG. 1 is a perspective view of the preferred embodiment of the invention showing the sole plate, wheel supports, and brake as connected to the skate boot and wheels;

FIG. 2 is an exploded perspective view of the preferred embodiment of FIG. 1 showing the various components of the invention aligned for assembly;

FIG. 3 is a side elevational view of the preferred embodiment of the invention of FIG. 1 resting on a level horizontal surface;

FIG. 4 is a side elevational view of the preferred embodiment of the invention of FIG. 1 showing the rear wheels riding over uneven terrain;

FIG. 5 is a side elevational view of the preferred embodiment of the invention of FIG. 1 showing the skate boot angled back to engage the brake with the rear wheel with both wheels of the rear wheel support resting on the horizontal surface;

FIG. 6 is a perspective view of the preferred embodiment of the invention having two pivotable wheel supports (trucks), a truck link, and alternate wedge-shaped compressible bumpers with inner core openings, and changeable compressible core inserts;

FIG. 7 is an exploded perspective view of the components of the preferred embodiment of FIG. 6 aligned for assembly;

FIG. 8 is a side elevational view of an alternate embodiment of the invention having a series of pivotally interconnected wheel support brackets and bumpers attached to a mounting plate on the skate boot;

FIG. 9 is an exploded perspective view of the components of the alternate embodiment of FIG. 8 aligned for assembly;

FIG. 10 is a perspective view of the alternate embodiment of the invention of FIG. 8 mounted on the skate boot;

FIG. 11 is a side elevational view of the alternate embodiment of the invention of FIG. 8 with very large outer wheels and very small inner wheels;

FIG. 12 is a side elevational view of the alternate embodiment of the invention of FIG. 8 with large outer wheels and small inner wheels;

FIG. 13 is a side elevational view of a variation of the alternate embodiment of the invention with a single pivot wheel support bracket with the bumpers angled toward the center;

FIG. 14 is a perspective viewing showing a rigid guard with a flexible accordion pleat attached to the skate boot and extending downwardly to shield the suspension system and a portion of the wheels;

FIG. 15 is a front elevational view showing a wheel in a straight upward position showing the smooth portion contacting a level terrain and the treaded portion contacting an uneven terrain;

FIG. 16 is a front elevational view showing a wheel in a tilted position as in rounding a

corner or pushing off with the tread contacting the level terrain.

Best Mode for Carrying Out the Invention

In FIGS. 1-5 and FIGS. 6 and 7, the preferred embodiment compound suspension system for inline skates enables independent shock absorption for each wheel 40. The compound suspension system is attachable to a bottom of a skate boot 50 by means of a sole plate 39 which is riveted or otherwise permanently secured to the sole of the skate boot.

A wheel support means comprises at least one pivotable wheel support member or support 90, 90A and 90B which is attached to the skate boot by an attaching means (or multiple movement means) for pivotally attaching the wheel support member at an imaginary pivot point (not shown) to the bottom of the boot and allowing the wheel support member to move horizontally and vertically relative to the boot at the imaginary pivot point. The attaching means includes a receiving element 33 and 33A which is provided with at least one combined vertical and horizontal slot 31 and 31A and a pivotable element, such as a rod 34 with screws 32, inserted within the receiving element so that the pivotable element is capable of vertical, horizontal, and pivotal movement with the receiving element 33 and 33A.

The pivotable wheel support member 90, 90A and 90B also preferably has means for supporting at least two wheels rotatably therein. The provision of two or more wheels rotatably supported on the front wheel support member 90A is advantageous in that it allows both front wheels thereof to stay on the ground during the skater's push off or stride. This enables a more natural push off, providing more power and a better workout using more muscle groups.

Continuing and as shown in the Figures, the front pivotable wheel support member 90 and

90A and rear pivotable wheel support member 90 and 90B, each have a top portion with openings 98 attached to the sole plate by a pivotable means, such as a rod 34 and screws 32, and a bottom portion with side walls 97 for retaining the wheels 40. A bottom outer portion 96 has outer axle openings 94 with one of the outer wheels 40 rotatably attached thereto by an axle means 42 and a bottom inner portion 95 has inner axle openings 93 with one of the inner wheels 40 rotatably attached thereto by an axle means 42.

A rigid link member 100 and 100A is attached by pivotable means, preferably part of the axle assembly of the inner wheels, between the inner bottom portions 95 of the wheel support members to add stability and prevent contact between the inner wheels.

A shock absorbing means such as a wedge 20, 20A and 20B of resilient compressible material, preferably URETHANE®, is attached between the sole plate 39 of the skate boot 50 and the at least one pivotable support member 90, 90A and 90B in communication therewith cradled in the V-shaped portion of the wheel support member formed by angled transverse walls 92, 92A and 92B, so that movement of the wheel support member caused by the wheels passing over variable terrain is absorbed by the shock absorbing means.

In FIGS. 6 and 7, the shock absorbing means comprises a wedge-shaped bumper 20 formed of resilient compressible material, such as URETHANE®, and each of the wheel support members 90 further comprises a V-shaped cradle on the top portion, formed by an upwardly angled outer surface 92A and an upwardly angled inner surface 92B connected thereto, for receiving the wedge-shaped bumper 20 therein. As the outer wheel moves upwardly in response to changing terrain, the wheel support member 90 pivots the outer surface 92A to compress the wedge-shaped bumper 20, and as the at least one inner wheel moves upwardly, the wheel support

member 90 pivots the inner surface 92B to compress the wedge-shaped bumper 20. Accordingly, vertical and horizontal movement of the wheel support member as well as combinations of such movement, including pivoting, is absorbed by the wedge-shaped bumper. As such, it will be appreciated that the shock absorbing means or bumper 20 will be engaged (to absorb shock) when the wheel support member pivots at the imaginary pivot point referred to earlier or moves horizontally and/or vertically at the imaginary pivot point.

In FIGS. 6 and 7, the alternate embodiment of the wedge-shaped bumper 20 is provided with at least one hollow core 23 extending transversely across the wedge-shaped bumper. A changeable compressible core insert 70 with at least one core insert pin 73, preferably of URETHANE® having any desired compressibility, is insertable in the hollow core so that the core insert alters the compressibility of the wedge-shaped bumper.

In the alternate embodiment, the wedge-shaped bumper is provided with two hollow cores 23, each of the cores positioned in proximity to one of the upwardly angled surfaces 92A and 92B of the V-shaped cradle. A pair of core insert pins 73 are interconnected by a handle portion 75 to form a two-pinned core insert 70, the pair of core insert pins being capable of being inserted in the two hollow cores and changed as desired with other core inserts having different densities with different levels of compressibility.

The core insert may have at least one air-filled bladder 76 therein and also may have a pump 77, operable by hand, in communication with the air-filled bladder, the pump capable of pumping air into the air-filled bladder.

In FIGS. 6 and 7 the inner portion 95 of the wheel support 90 comprises two holes 93 and 93A in each of the side walls 97. One of the holes 93A is positioned higher than the other of the

holes 93 to receive a rotating means of attaching the inner wheel 40 in a higher position than the outer wheel for a rockering effect.

In FIGS. 1-5, a brake 120 is provided having a brake housing 121 with a cylindrical opening therein containing a brake element130 having a high friction contact portion133, preferably formed of grindstone material. When activated as described below, the high friction contact portion of the brake will contact one of the skate wheels 40, preferably the rear wheel, to slow and if desired eventually stop the wheel from rotating, thereby serving as a brake.

The brake housing 121 is attached at its upper end to one end of the skate, preferably the rear of the skate, by a pivotable and vertically slidable means formed by a bracket 127 which in turn is rigidly attached to the rearward end of the skate boot, preferably formed with the sole plate 39 or inserted therein. As shown, bracket 127 defines a vertical slot 126 therein which receives a pivotable element fit slidably therein, such as a rod 34 and screws 32 fit through openings 125 of parallel walls 124 extending from the brake housing 121.

In addition, the lower end of the brake housing 121 is connected to the rear wheel supports 90B by a pivotable means. The pivotable means, as shown, includes an arm 123 extending from the brake housing 121 which is provided with laterally protruding snap fit pins 19 at its distal end. As shown, pins 19 snap into openings 141 in a vertical bracket 140 provided in rear wheel support 90B and thereby permit pivotal movement therein.

As will be appreciated from FIG. 4, when rear wheel support 90B is caused to move upwardly due to changes in the terrain, rod 34 will slide vertically or upwardly in slot 126 of bracket 127. Since rod 34 is attached to the brake housing 121, the brake housing will also move vertically or upwardly when this action occurs, thereby insuring that the brake housing high

friction contact portion 133 will not contact the outer surface of the outer rear wheel 40B to accidentally brake or slow the wheel. From the following discussion, it will be appreciated that this movement of the brake element in conjunction with the rear wheel support occurs when the skater's weight is distributed equally to the front and rear wheel supports 90A and 90B.

When, however, as shown in FIG. 5, the skater rocks backwards on the skate to place more weight on the rear wheel support 90B than on the front wheel support 90A, the high friction contact portion 133 of the brake will pivot about pins 19 (see arrow) into contact with the skate wheel 40B to slow and/or brake the wheel. The front wheels 40A of the skate will usually be elevated in this braking position, with the rear two wheels 40B remaining in contact with the ground for stability. The rod 34 will not slide upwardly or vertically when the heel is pressed downwardly because the pivoting action about pins 19 causes the angle of slot 126 to change slightly which, in turn, causes rod 34 to impact against the inner side surface 129 of slot 126. As such, the inner surface 129 of the slot acts like a cam surface to prevent upward movement of the rod in the slot, thereby insuring that the high friction contact portion 133 pivots about pins 19 to make contact with the rear wheel 40B to slow and/or brake the wheel, i.e. when the skater rocks backwards on the skate (thereby shifting his or her weight) to place more weight on the rear wheel support 90B than on the front wheel support 90A as previously discussed.

In addition, as best shown in FIGS. 1 and 2, the skate is also provided with brake sensitivity means (not numbered) for adjusting the minimum amount of weight which the skater has to place on the rear wheel support 90B to move brake element 130 into contact with rear wheel 40B. This is provided by adjustably fitting brake element 130 having the high friction contact portion 133 at one end thereof within the brake housing 121. The brake element 130 is

made adjustably fittable within the housing by first threading a threaded a non-rotating portion 131 onto a threaded portion 132 of the brake element. The non-rotating portion is received in a complementarily shaped hole (not numbered) provided in housing 121. As will be appreciated, the received non-rotating portion 131 prevents the brake element from rotating which could occur if the threaded portion 132 were to rotate when the twisting cap 128 is rotated. The twisting cap 128 having a threaded bore (not shown) and tabs 122 is then threaded onto the threaded end 132 of the brake element until the tabs fit into complementarily shaped receiving portions (not shown) defined by housing 121 which permit the cap 128 to rotate in the housing but prevent it from being pushed out of the housing when a braking force is applied. As will be appreciated, by turning or twisting cap 128 threaded portion 132 of the brake element is threadably moved along its longitudinal axis within the housing, thereby adjusting the proximity or distance of the contact portion 133 from the surface of wheel 40B. This allows one to adjust the sensitivity of the braking system, i.e. the minimum amount of weight which the skater has to place on the rear wheel support to move the brake element into contact with the rear wheel.

FIGS. 8-13 show an alternate embodiment of the suspension system and wheels for inline skates enabling independent movement of each wheel, which system is attachable to a bottom of a skate boot 50, 50A, and 50B by a sole plate 39B-39E.

In FIGS. 8-13 the alternate embodiment of the compound suspension system comprises at least one pivotable wheel support member 90A and 110 attached to the skate boot by a pivotable pin means 86, such as a metal shaft, from a pair of brackets 82 or flanges, each having a flange hole 31A laterally therethrough, on a sole plate 39B-E attached to the sole 52 of the boot. The pivotable pin 86 fits rotatably in an opening, such as a slotted opening, such as the curved slot 91

in the shape of an arc, in a top portion of the wheel support member. The curved slot 91 allows the front and rear pivotable support members 90A to pivot around the pin and to move within the slotted hole as the outer and inner wheels go up and down in response to changes in the terrain.

A front and a rear shock absorber, such as a URETHANE® bumper shock absorber 38, a hydraulic shock absorber, or a spring. attached to the sole plate 39B-E on an angled protrusion 81 and 81A in contact with a flat shock plate 92 formed between the two sides of each wheel support member. The brackets 82 and angled protrusions 81 and 81A are formed integrally with the sole plate in the plastic molding process. The sole plates 39B-E are attached to the sole 52 of the boot by conventional means, such as riveting.

In FIGS. 8-12 the front and rear pivotable wheel support members 90A each have a top portion attached to the skate boot by a pivotable means, such as the curved slot 91 and each having a bottom end portion 96 (best seen in FIG 9) with an end wheel 40, 40D, and 40F rotatably attached thereto on end axle pin 85 through end opening 94 and a bottom inner portion 95 with an inner wheel 40, 40E, and 40G rotatably attached thereto on inner axle pin 87 through inner opening 93. An inner connecting member in the form of a rigid link 100A, 100B, and 100C is attached at each end 105 by pivotable means, such as the inner axle pin 87 through end openings 101, between the bottom inner portions 95 of the front and rear pivotable wheel support members 90A. An inner bumper/shock 38A, 38B, and 38C is attached to the sole plate 39B, 39C, and 39D in contact with a top flat shock plate surface 102 on the inner connecting member to absorb shock therefrom. There may be a space left between the shock plates and the bumper/shocks for added flexibility of movement.

In FIG. 8, an alternate brake 60 formed by a rigid angled arm 62 attached by a pivotable

means, such as a pivot pin 63 to the sole plate 38D. The rigid arm 62 has at one end a pivotable brake wheel 61 attached by an axle pin means 68 for contacting the ground upon tipping the skate boot toward the brake and the rigid arm has at the other end a high friction surface 67, such as brake shoe material, on a pivotable member 66 attached by a pivot pin means 65 for contacting one of the wheels for braking upon contact of the braking wheel with an external riding surface. A spring 69 biases the brake normally away from the wheel.

Different sizes and combinations of wheels permit optimal performance in different skating applications such as street hockey, racing, fitness, extreme, and now cross-country or downhill or off-road as the possibilities are opened up with the current invention. The alternate embodiment of FIGS. 8-10 are shown with 76mm diameter wheels although other sizes may be employed with this embodiment by varying the sizes of the components.

In FIG. 11 very large end wheels 40D, such as 101mm diameter wheels, are mounted on the end openings held by axle pins 85 and very small inner wheels 40E, such as 50mm diameter wheels, are mounted on the inner openings held by inner axle pins 87. In this configuration a smaller inner connecting member 100B and longer central URETHANE® bumper/shock absorber 38B are used to accommodate the smaller inner wheels.

In FIG. 12 moderately large end wheels 40F, such as 89mm diameter wheels, are mounted on the end openings held by axle pins 85 and moderately small wheels, such as 63mm diameter wheels, are mounted on the inner openings held by inner axle pins 87. In this configuration an intermediate size inner connecting member 100C and intermediate size URETHANE® bumper/shock absorber 38C are used to accommodate the intermediate size inner wheels.

In FIG. 13 the suspension system comprises a single pivotable wheel support member 110

having an upper portion attached at a central point to the skate boot by a sole plate having a pivotable means, such as metal pin 86 through an opening (not shown) in the wheel support member. Two end portions of the single pivotable wheel support are each in contact on flat shock plate 92 with a bumper/shock 38 attached at an inwardly pointing angle by protruding shock supports 81A on the sole plate 39E, so that as each of the wheels contacts a variation in the terrain the wheel may move up and down with the shock being absorbed. Any desired number of wheels and any desired sizes of wheels may be used with a single pivotable wheel support member. While the FIG. 13 shows four wheels, two, three, five, or more wheels may be used by providing the single pivotable wheel support member with the appropriate number of holes to receive the pins 85 to mount the wheels.

A sheet of URETHANE® 38D may be sandwiched between the sole plate 39B-E and the sole 52 of the skate boot for additional shock and vibration absorption.

In FIG. 14, a rigid guard 48 is rigidly attached to the skate boot 50 bottom by a connecting means, such as rivets 55, and extends downwardly therefrom around the suspension system to cover and protect the suspension system and a portion of the wheels 40. The guard 48 may further comprise a peripheral accordion pleat 53 portion of the guard to allow the guard to flex up and down with movement of the wheels.

A series of wheels 40 are attached by rotatable means, such as outer and inner axle pin means 85 and 87, to the suspension system in a linear array and extend downwardly therefrom. The wheels 40 may be conventional skate wheels or all-terrain type wheels structured with a smooth center peripheral strip 44 for smooth running on smooth pavement and angled rounded side peripheral strips 47 having transverse treads 41 for traction on rough terrains and when

pushing off with the skates, as seen in FIGS. 15 and 16. The wheels are fabricated of rubber, NEOPRENE®, URETHANE®, or other air tight, resilient, rugged material to withstand rough terrain. The wheels may be inflatable air-filled wheels filled through an air stem 43 as seen in FIG. 8.

The skate boot 50 and 50B may be fabricated of molded plastic or leather with a rigid plate type skate boot bottom 52 for attaching the suspension system and the wheels thereto. In FIGS. 11, 12, and 13 the skate boot 50 is laced together to secure the skate boot to a foot of a wearer. In FIG. 10 the skate boot 50B has overlapping closure flaps 55 securing the boot together by adjustable two-piece hook and loop fasteners 56.

In operation the wheels absorb some of the shock and deform resiliently to small rocks or other obstacles, while the shock absorbing system absorbs larger shocks from major obstacles, grade changes, jumps, or other disturbances which might otherwise jolt the user. The skater can go off of smooth roads and sidewalks and ride on rough terrain in relative comfort and safety not afforded by skates with more rigid and smaller wheels and suspension systems.

It is understood that the preceding description is given merely by way of illustration and not in limitation of the invention and that various modifications may be made thereto without departing from the spirit of the invention as claimed.